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(71) Applicant and
(72) Inventor: GUERRASIO, Antonio [IT/IT]; Via Nuova Ponte, 14, I-84086 Roccapiemonte (IT).

(74) Agent: CIRILLO, Gennaro; Via S. Lucia, 15, I-80132 Napoli (IT).

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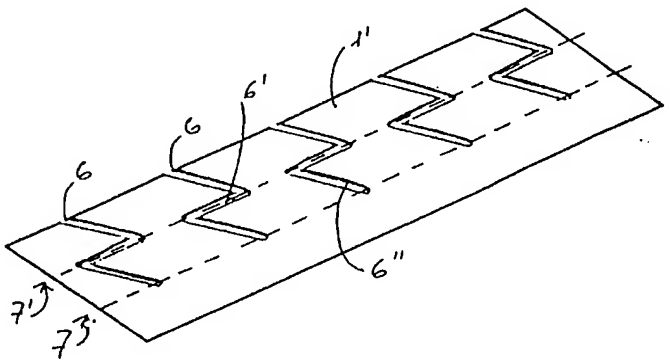
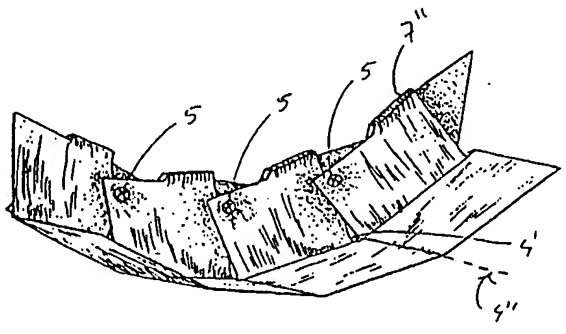
(54) Title: METHOD OF MANUFACTURING STRUCTURAL SHAPES THAT CAN BE BENT BY HAND AND STIFFENED WITHOUT ANY FURTHER WELD MATERIAL, AND STRUCTURAL SHAPES OBTAINED THEREFROM TO BE USED AS ROUND CONSTRUCTIONS FOR WALLS, FALSE CEILINGS AND THE LIKE



(57) Abstract: A method of manufacturing structural shapes by cutting slots in plates preferably of metal an then shaping the same to obtain structural shapes that can be bent by hand and stiffened by punching pliers or fastening screws to block permanently the material of the structural shape also without using stiffening ribbings as additional materials. This feature is the novel basic concept of the present invention and is applied to obtain a wide rang eof different structural shapes that can be used in buildings and for particular technical solutions.



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method of manufacturing structural shapes that can be bent by hand and stiffened without any further weld material, and structural shapes obtained therefrom to be used as round constructions for walls, false ceilings and the like.

In recent years, the light prefabricated building, particularly the inside finish, has had a considerable development regarding metal carrying structures to which lined plaster panels are fastened by screws.

Thanks to the lightness of such structures and their easy handling and assembling, the "dry" technology is ideal for redevelopment and architectural design in dwelling and non-dwelling places.

Designers can suggest architectural solutions of the curved type as there are commercially available metal sections that can easily be bent by hand to provide manufactured articles such as arches, round walls, round false ceilings, as well as all-type vaults.

Such structural shapes are based upon compacted, previously slotted sections provided with folds acting as "hinges" which allow box-like sections to be pivoted to one another by hand so that they take a curved shape to be stiffened, however, by using a template or a rigid ribbing member screwed thereto to block the "hinges", thus preventing any swinging.

Furthermore, the present state of art provides other types of structural shapes that can be bent by hand about yielding notches and slots in the material. However, they also need stiffening templates to be secured thereto in their desired shapes.

The present industrial invention seeks to provide a method of manufacturing structural shapes and the structural shapes

obtained therefrom that can easily be bent by hand and blocked in their final shapes by punching pliers, screws or other suitable fastening means without using templates or rigid ribbing members to block the bent sections in their desired shapes.

This object is achieved by slotting the flat starting band to form elongated and/or transversal slanting slots with a suitable pitch along with squeezed folds and orthogonal bends to provide a structural shape having the features described above.

The flat band is cut beforehand both by forming elongated slots and transversal slots inclined to the central axis. Further slotting to remove material away can also be provided to form suitable coupling recesses for snap-fitting further shapes.

The shaping of the cut band is made according to the previous slotting and the desired section of the structural shape.

The novel method of manufacturing structural shapes consists of three simultaneously coexisting mechanical methods of shaping structural shapes which will be described below in detail.

One mechanical method of the present invention allows a structural shape to be curved by weakening the material by slotting it with a defined pitch in the longitudinal direction so that the curved surface of the material is split up so as to come near to a continuous curved line.

Another mechanical method of the present invention causes surface portions of the structural shape to pivot to each other so as to be positioned in facing relationship and squeezed after a turnover of one surface portion by 180° with respect to the other surface portion.

Still another mechanical method of the present invention allows the structural shape to be self-blocked and stiffened by connecting the overturned opposite surface portions of the

structural shape to each other by securing means such as punching or fastening screws.

During bending the structural shape is rotated at the same time about an axis perpendicular to the plane of bending as well as the opposite slotted surface of the structural shape are caused to slip on each other, such surfaces being either partially connected to or completely separated from each other.

Once the desired position is reached, such surfaces are blocked to each other by self-tapping fastening screws or a particular tool, so-called "scold pliers", that punches the surfaces and causes material to penetrate and to form an unrolled burr, that fastens the surfaces to each other and prevents them from any rotation.

Such operation is repeated along the structural shape at the weakened slotted portions.

The three mechanical methods described above coexist in all types of structural shapes illustrated in the accompanying drawings.

The practical applications are considerable: round walls, arches, round perimetrical members, barrel vault, round vaulting cells, round T-shaped constructions, H-shaped constructions, undulated false ceilings, lined round perimetrical members for metal ceilings, etc.

The advantages achieved are self-evident and mainly consist of:

- a shorter time of manufacturing the round structural shapes;
- a lower material cost;
- a lower material waste;
- suppression of the stiffening templates of the round structural shapes;
- a greater safety factor of the suspended carrying structure;
- a very easy integration into the existing types of structural

shapes;

- assembling of a system of structural shapes all of them being able to be bent and stiffened according to the same principles.

The solution suggested by the present invention will be better understood with reference to the accompanying sheets of drawings showing some indicative, not limiting embodiments.

Fig. 1 of sheet I shows a band, preferably of metal, in which two rows of slanting notches are cut in the side edges of the band with a length about ¼ as long as the width of the band;

Fig. 2 shows a squeezed band bent at the central axis;

Fig. 3 shows the L-shaped structural shape obtained by bending the band of Fig. 2 at right angle in the middle;

Fig. 4 shows the cross section of the shape of Fig. 3;

Fig. 5 shows a curved, structural shape stiffened by fastening screws in a S-shaped configuration having both concave and convex bendings;

Fig. 6 of sheet II shows a band, preferably of metal, in which Z-shaped slots with a defined pitch which are 2/3 as long as the length of the band are cut;

Fig. 7 shows the L-shaped structural shape obtained by a double bending of the slotted band, the first one being a squeezed bending, the second one being a 90° bending, both bendings being

1/3 as wide as the width of the band;

Fig. 8 shows the cross section of the structural shape of Fig. 7;

Figs. 9 and 10 show the bent structural shape stiffened by fastening screws both in concave and convex curvatures.

Fig. 11 of sheet III shows a band, preferably of metal, provided with Z-shaped slots with a defined pitch formed centrally and being ½ as long as the width of the band;

Fig. 12 shows a T-shaped structural shape obtained by a squeezed bending at the central axis and two opposite bendings at 90°;

Fig. 13 shows an alternative embodiment of the T-shaped structural shape provided with a flat lining inserted thereon;

Fig. 14 shows the section of the structural shape of Fig. 12;

Fig. 15 shows the bent structural shape of Fig. 13 and stiffened by fastening screws.

Fig. 16 of sheet IV shows a band, preferably of metal, having two parallel rows of Z-shaped slots with a defined pitch formed at the outer sides of the band so that the central portion equal to the half width of the band is not slotted;

Fig. 17 shows a structural shape obtained by bending the slotted portion to provide a U-shaped section, as shown in Fig. 18;

Fig. 19 shows a possible application of the structural shape as arch, in which supporting uprights for stiffening the carrying structure are provided;

Fig. 20 shows the details of such an arch.

Fig. 21 of sheet V shows a structural shape obtained from a band, preferably of metal, by slotting and shaping it in the form of "Ω", as shown in Fig. 22;

Fig. 23 shows a curved structural shape stiffened by fastening screws, to which a further shape is snap-fitted, said structural shape being suspended to a hook and an adjusting spring;

Fig. 24 shows an application of the structural shape described above in a barrel vault.

Fig. 25 of sheet VI shows a particular T-shaped structural shape bent and stiffened by punching pliers and made by applying the method of forming T-shaped structural shapes according to the present invention, such structural shapes being shown both with concave and convex curvatures;

Fig. 26 shows the cross section of the T-shaped structural shape;

Fig. 27 shows a particular embodiment of the notches to avoid the overlap of the surfaces when the structural shape is bent inside the slotted portion;

Fig. 28 shows the structural shape of Fig. 3 having a slotted

portion provided with a particular extensible band which allows the structural shape to be used as curved perimetrical member for finishing metal false ceilings, as shown in Fig. 29.

Figs. 30 to 39 of sheet VII show some sections of structural shapes to which the solutions of the present invention are applied.

With reference to the Figures, the structural shape of Fig. 3 essentially consists of a band (1), preferably of metal, provided with slanting slots (2) and (2') with a defined pitch parallel to one another and cut into the side edges of the band which is then bent and squeezed along its longitudinal axis (3) and further folded by 90° along axis (4) so that points (4') on the structural shape are the centres of the rotation axes (4") laying on the plane perpendicular to such axes which is also the plane of the notches of the opposite edges.

Once the structural shape is bent according to the desired shaping, the ends of the opposite surfaces are blocked to each other by suitable self-tapping fastening screws (5); the blocking is easily carried out as some material will always be present in opposite positions because of the presence of the slanting notches (2) and (2'). If the slanting notches are not separated but connected to one another by slots, an overall Z-shaped slot is obtained consisting of slots (6) and (6") parallel to each other and connecting slot (6') located centrally on band (1') along the squeezing bending axis (7'). The L-shaped structural shape shown in Fig. 7 is obtained by bending it by 90° along axis (7).

Also in this structural shape the bending is obtained by carrying

out the methods described above as well as the stiffening and the blocking of the opposite surfaces to each other by fastening screws (5). In this case, the structural shape is even more stiffened with respect to the structural shape illustrated in Fig. 5 as the opposite surfaces are partially connected to each other by ridges (7") which prevent the surfaces of those portions of the structural shape from slipping.

If a Z-shaped slotting is made centrally in a band (1") the side ends of which are not cut, the structural shape shown in Fig. 12 is obtained by a squeezed bending of the band along axis (8) and by bending the two ends by 90° in a divergent manner. A lining shape (9) is inserted to such structural shape, as shown in Fig. 15. Such structural shape finds application in round false ceilings of metal.

If a Z-shaped slotting is made on both sides of a band (1"'), the central portion of which is not cut, and squeezed bendings are made along the longitudinal axes (10) and (10") by folding the material about the same surface of the band and then by bending by 90° along axes (10') and (10"), the structural shape shown in Fig. 17 which is bent and stiffened by fastening screws (5) or by punching (11) is obtained. Both blocking systems are valid as well as other systems achieving the same final object are applicable.

A possible application of the U-shaped structural shape described above is shown in Fig. 19 in a carrying structure of an arch in a wall, while Fig. 20 shows the U-shaped guide bent and stiffened, in which uprights (12) are inserted.

If a Z-shaped slotting is made along with other particular slotting (13) and (14) to allow an easy, effective suspension (16) and (17) and the snap-fitting of other structural shapes

(15), the structural shape shown in Fig. 23 is obtained, while Fig. 24 shows a possible application both of the just described structural shape used as bent snap-fitted bar (18) and the bent perimetrical structural shape (18') already described and shown in Fig. 9.

If a Z-shaped slotting is made on a structural shape for T-shaped structures commonly used for modular panels of false ceilings, a novel, interesting technical solution for a bent T-shaped structural shape shown in Fig. 25 is obtained.

Technical, functional, performance improvements of the structural shapes can be obtained by adjusting the thickness of the materials, the shape of the slots, and the blocking system. For example, Fig. 27 shows a notch (19) preventing the overlap of the material (20) during the "closed" bending, while Fig. 28 shows a structural shape of the type of Fig. 3 which is lined by elastic PVC (21) and glued to the slotted surfaces (23) so as to allow such structural shape (24) to be used as bent perimetrical finishing members for false ceilings of metal, as shown in Fig. 29 about a round pillar to which the structural shape is secured along the not slotted surface (22).

In conclusion, even if the structural shapes have different sections, they were proved to be made according to the same inventive concept that allows the same to be easily bent by hand and self-stiffened without resorting to other additional material that blocks the weakened portions of the slotting.

Formal, structural changes and modifications may be made to the inventive solution without departing from the scope of the present invention as defined in the appended claims.

Claims

1. A method of manufacturing structural shapes that can be bent by hand, characterized by the following steps:

- cutting elongated and/or transversal slanting slots with suitable shapes and defined pitch;

- providing one or several squeezed bendings to form one or more longitudinal ribbings as well as further bendings perpendicular to said ribbings provided that any squeezed bending is made at the axes of the longitudinal ribbings and the axes of said perpendicular bendings pass through the ends of the slanting transversal slots so as to form both opposite and overlapped surfaces and slanting weakening opposite slots each having at least one end that will be the centre of rotation of the surfaces separated by the slots;

- such operative steps allowing the manufactured structural shapes to take curved configurations because of a relative slipping of the surfaces separated by the slots and a blocking and stiffening of the structural shapes according to the desired shapes.

2. The method of claim 1, characterized in that the band is cut with slanting transversal slots having a defined pitch and formed parallel to one another in the side edges of the band, the central surface of the same between the two rows of slots being free from slots, whereupon the band is bent and squeezed along the central longitudinal axis and then bent by 90° along the longitudinal axis passing through an end of the slanting transversal slots to provide a L-shaped structural shape.

3. The method of the preceding claims, characterized in that the ends of each longitudinal slot are connected to slanting transversal slots to form Z-shaped slots located centrally in the band, the two side edges being bent perpendicular to the slotted surface which is bent and squeezed along the axis of the longitudinal slots so that a T-shaped structural shape is obtained.

4. The method of the preceding claims, characterized in that the band is cut with Z-shaped slots having a defined pitch according to claim 3 and located so that only one side surface is free from slots and bent perpendicular to the slotted surface which is bent and squeezed along the axis of the longitudinal slots so that a L-shaped structural shape is obtained.

5. The method of the preceding claims, characterized in that the band is cut with Z-shaped slots having a defined pitch and located parallel to each other on both side edges of the band, the central surface of the same which separates the two rows of side slots being free from slots, the side slots being bent and squeezed along the axes of the longitudinal slots and then bent perpendicular to the free plane surface so that a U-shaped structural shape is obtained.

6. The method of the preceding claims, characterized in that after the band is cut with the Z-shaped slots having a defined pitch and after the following bendings, the band is free from slots both in the side surface and the surface between the two rows of Z-shaped slots so that a structural shape with a F-shaped section is obtained.

7. The method of the preceding claims, characterized in that after the band is cut with the Z-shaped slots having a defined pitch and after the following bendings, the band is free from slots both in the side surface and the central surface between the two rows of Z-shaped slots so that a structural shape with a double T-shaped section is obtained.

8. The method of the preceding claims, characterized in that the opposite overlapped surfaces make. it possible to block and stiffen the whole structural shape according to the desired shaping just by punching said surfaces or by blocking them by fastening screws or the like.

9. Structural shapes obtained according to the method of the preceding claims as shown partially in sheet VII of drawings.

10. Structural shapes obtained according to the method of the preceding claims, characterized in that the slots can be provided with a suitable shape in order to improve the capability of the desired structural shape of being bent and stiffened.

11. The structural shapes according to claims 9 and 10 and particularly according to the method of claim 3, characterized in that the side longitudinal edges free from slots are so shaped as to allow suitable structural shapes to be snap-fitted to obtain curved complex structural shapes.

12. The structural shapes according to claims 9 to 11 and particularly according to the method of claim 3, characterized in

that there is provided a strip connecting the longitudinal not slotted edges and further suitable slots with a defined pitch between the slotted surface portions to allow similar structural shapes to be inserted so that modular curved structural shapes are obtained.

13. Structural shapes according to claims 9 to 12 and particularly to the method of claim 2, characterized in that an extensible adhesive film of plastic material is stuck to the slotted surfaces so that a curved perimetrical finishing and the blocking of the structural shapes without screws or punching are obtained.

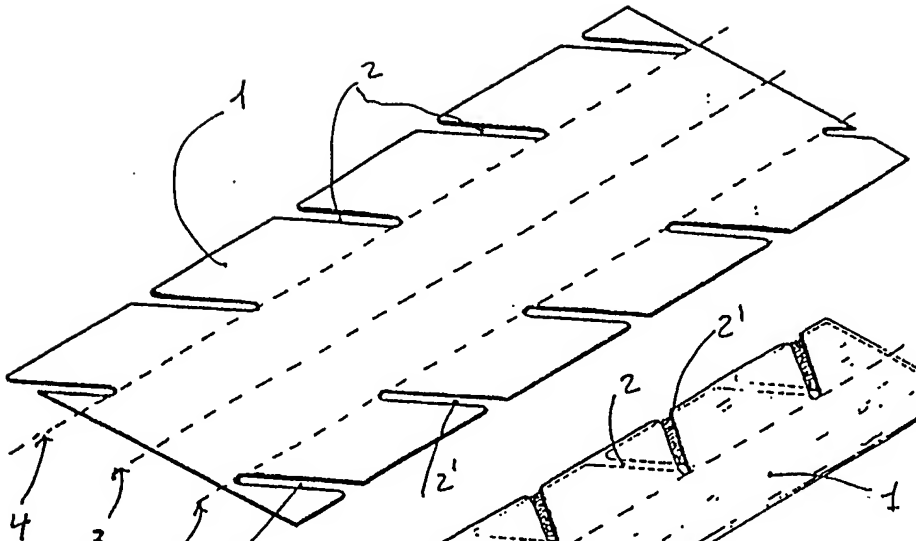

Fig. 1

Fig. 2

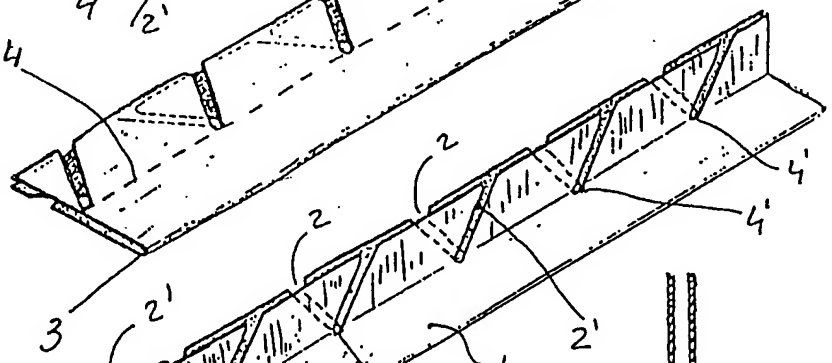

Fig. 3

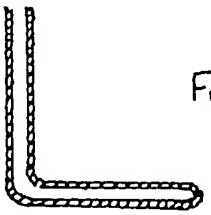

Fig. 4

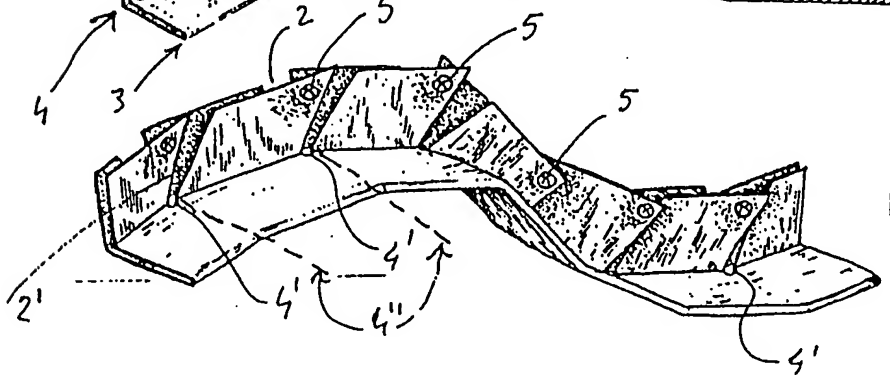

Fig. 5

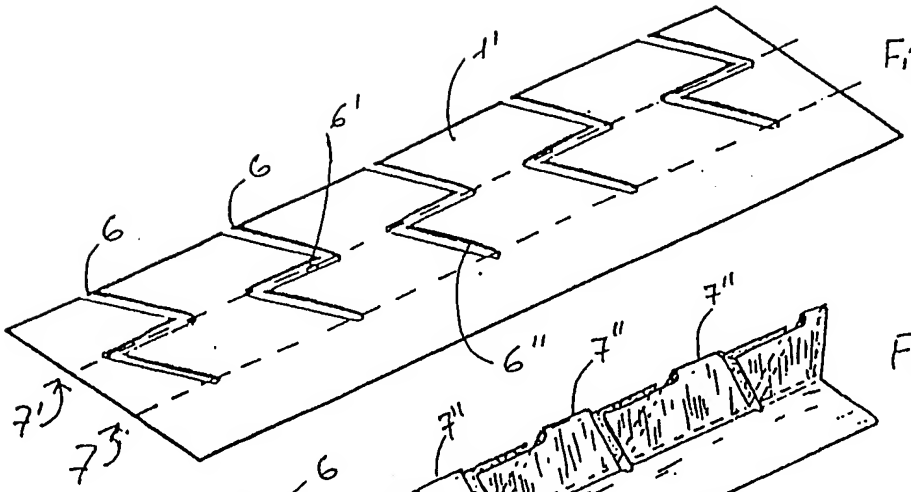

Fig. 6

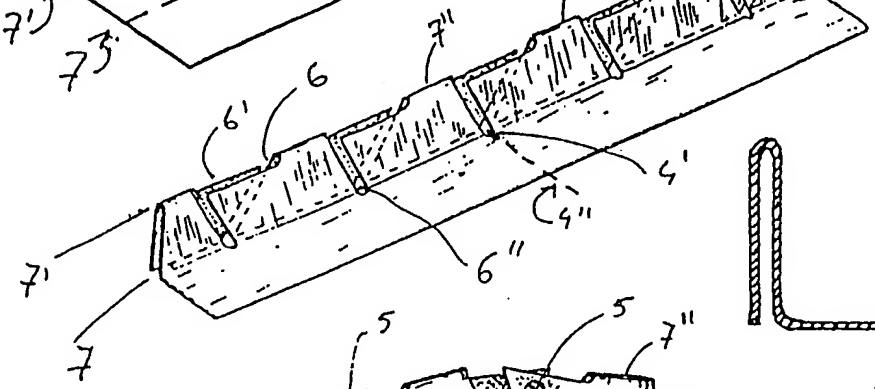

Fig. 7

Fig. 8

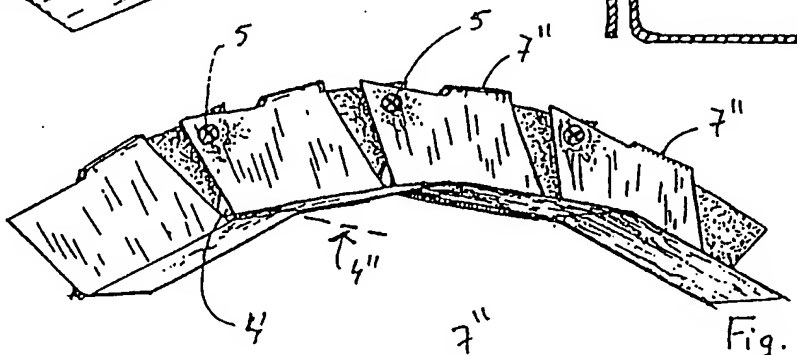

Fig. 9

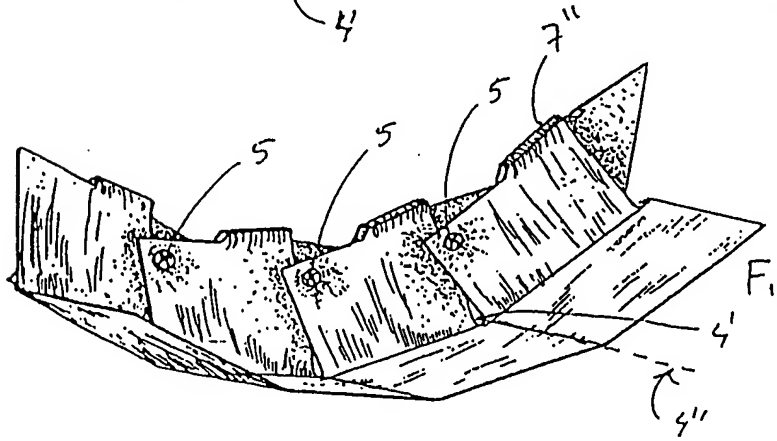

Fig. 10

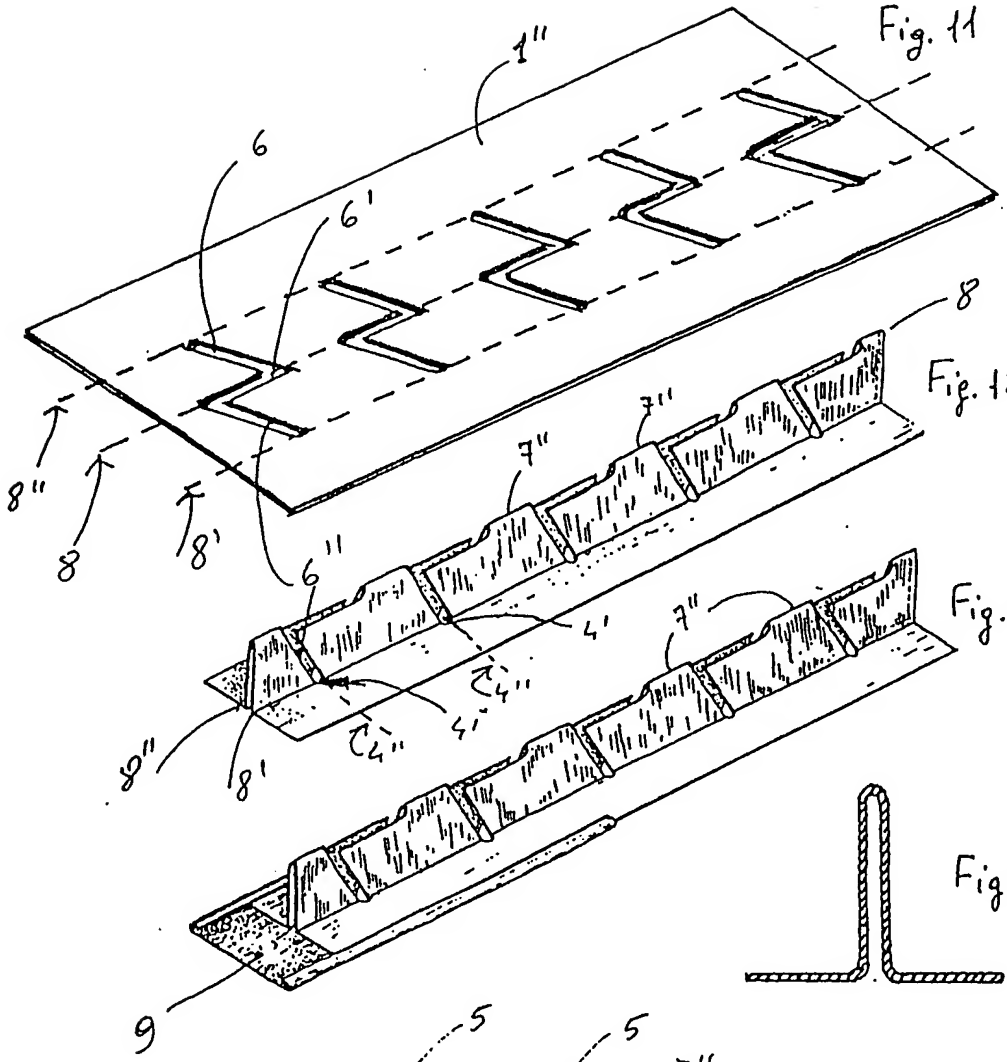

Fig. 11

Fig. 12

Fig. 13

Fig 14

Fig. 15

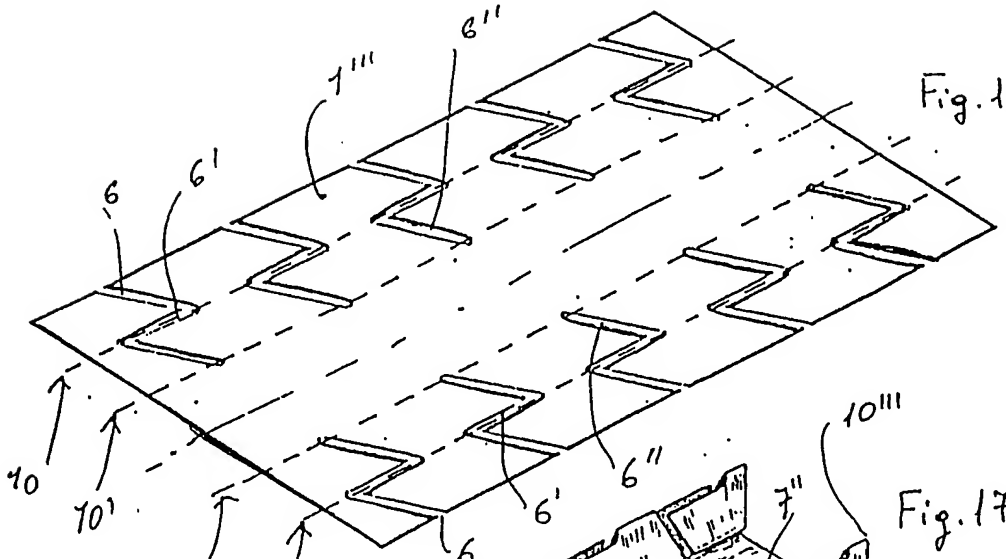

Fig.16

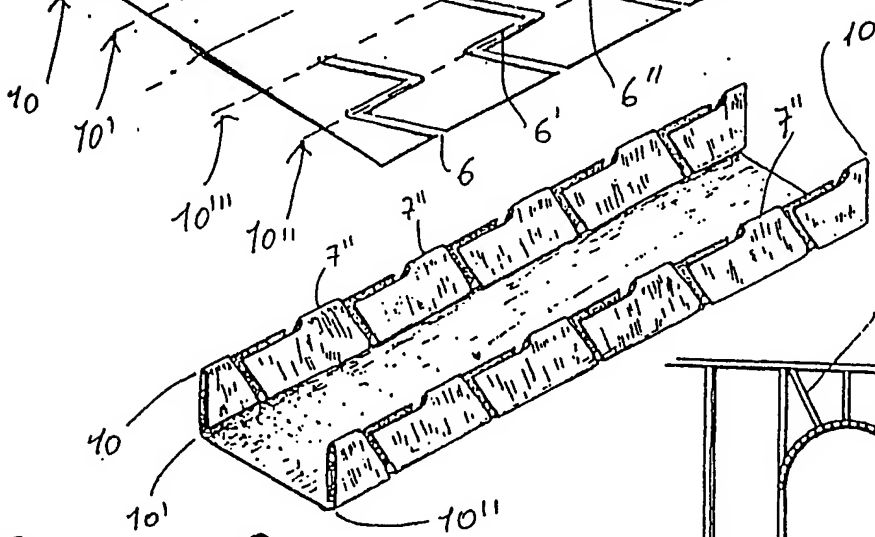

Fig.17

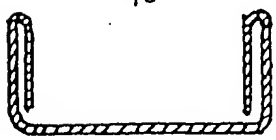

Fig18

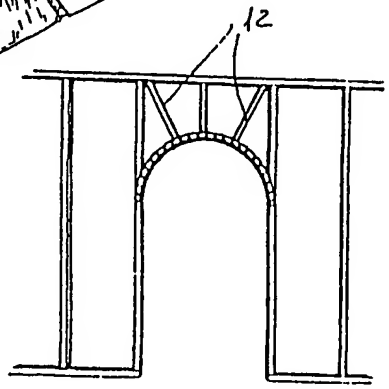

Fig.19

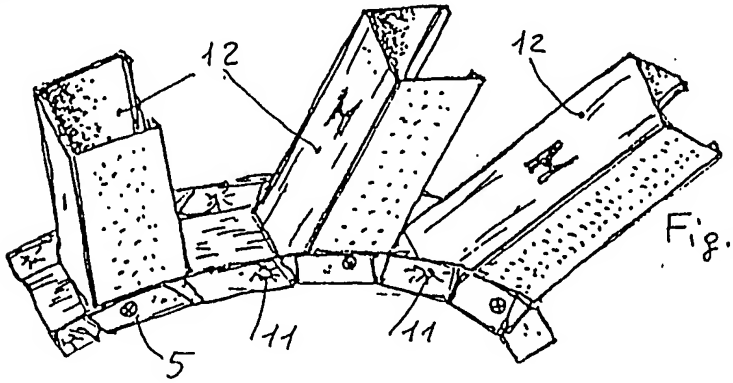

Fig.20

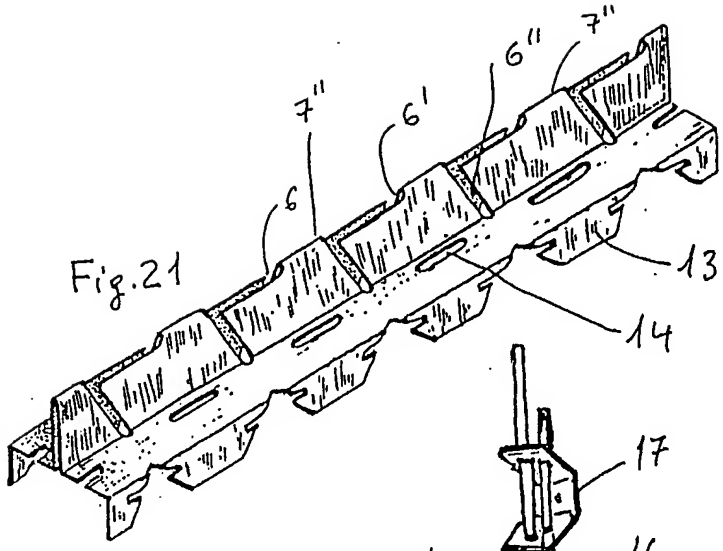

Fig.21

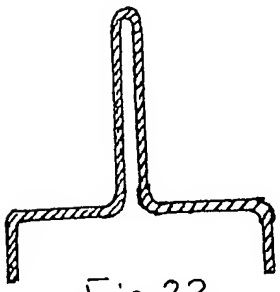

Fig.22

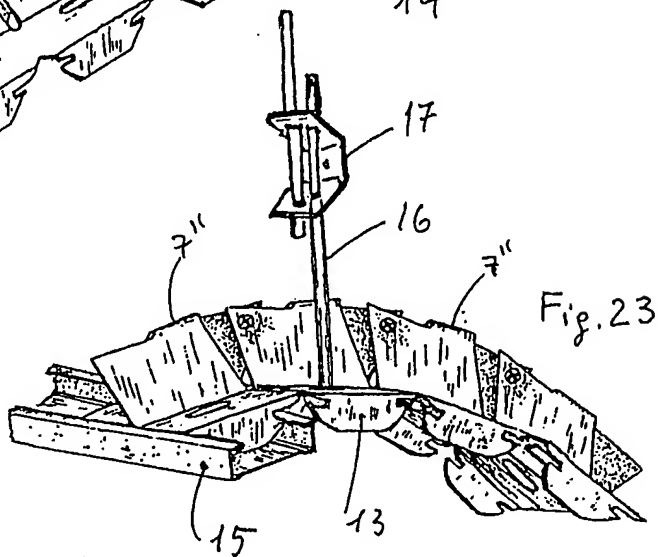

Fig.23

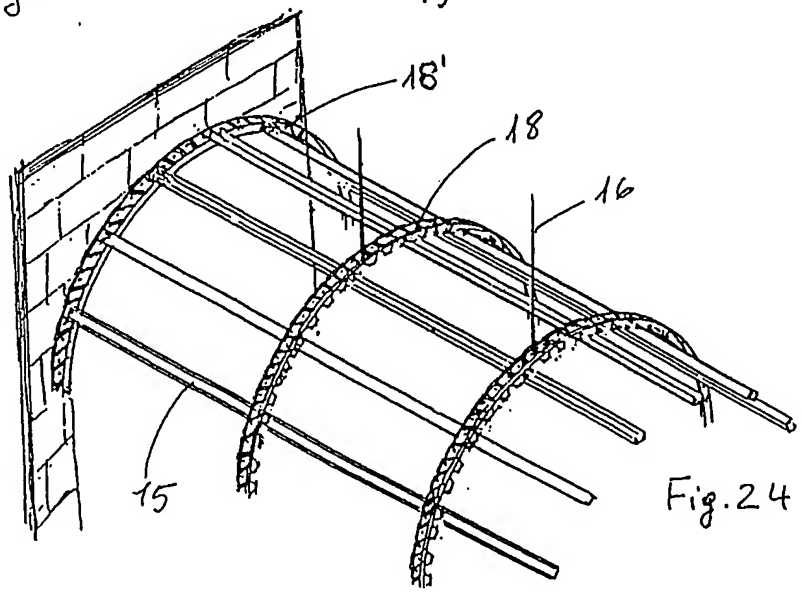

Fig.24

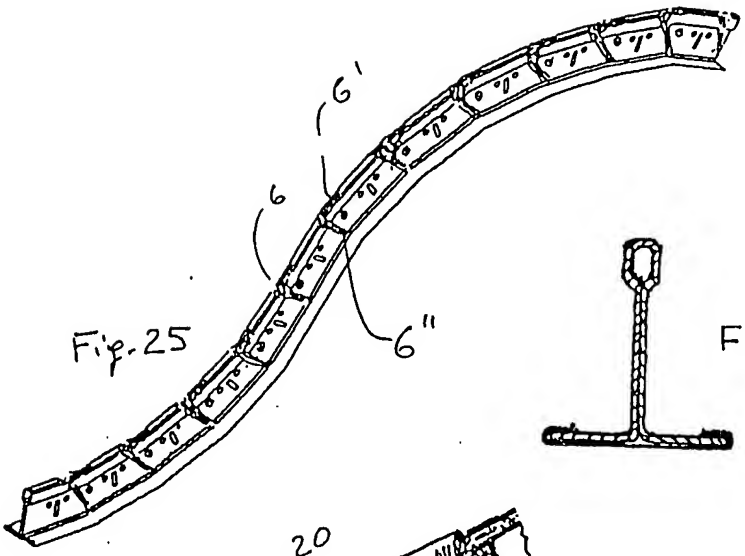

Fig. 25

Fig. 26

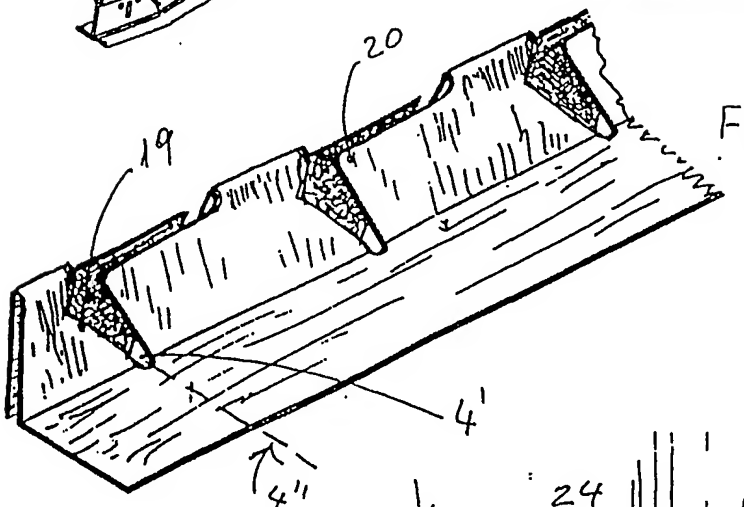

Fig. 27

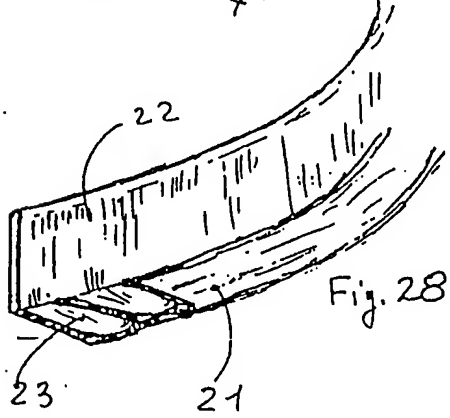

Fig. 28

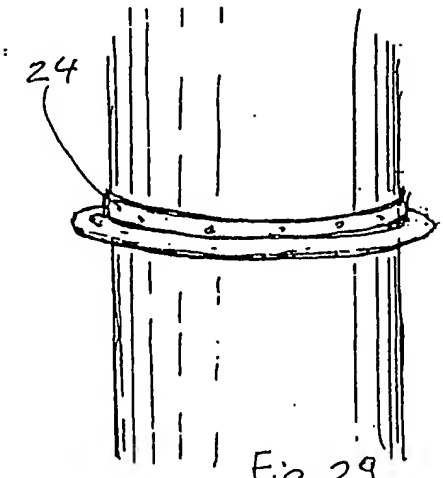

Fig. 29

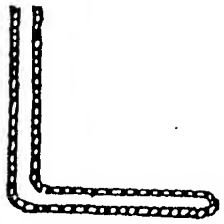

Fig.30

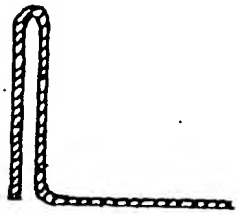

Fig 31

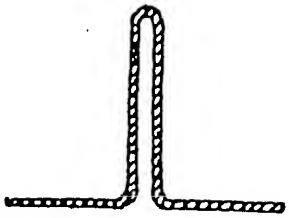

Fig. 32

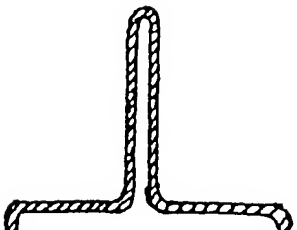

Fig. 33

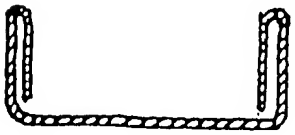

Fig. 34

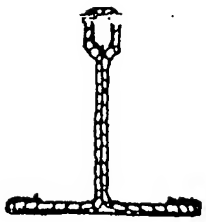

Fig. 35

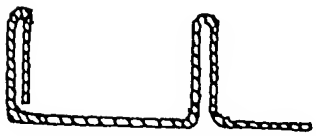

Fig. 36

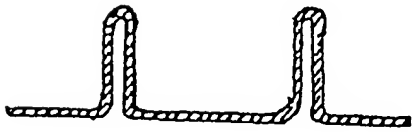

Fig. 37

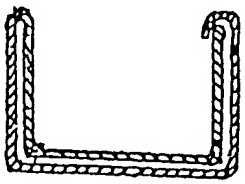

Fig. 38

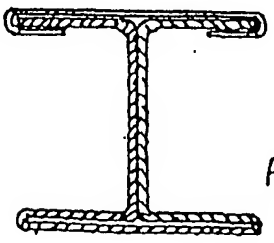

Fig. 39

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 01/00282

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04B9/06 E04B9/30 E04F13/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E04B E04C E04F F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 21669 A (ALUTERM) 6 May 1999 (1999-05-06) page 2, line 5 -page 3, line 14; figures	1-13
A	EP 0 604 376 A (GUERRASIO) 29 June 1994 (1994-06-29) abstract; figures	1-13
A	US 5 816 002 A (BIFANO ET AL.) 6 October 1998 (1998-10-06) abstract; figures	1,9
A	US 3 159 251 A (BECKER) 1 December 1964 (1964-12-01) the whole document	1,9,13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search	Date of mailing of the international search report
22 November 2001	29/11/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Righetti, R

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int onal Application No
PCT/IT 01/00282

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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